

8.—THE OCCURRENCE OF XENOTIME IN WESTERN AUSTRALIA,

By

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Read 14th November, 1939; Published 16th August, 1940.

In 1912 a few small dull yellow or pale brown octahedral crystals were detected during the examination of stream tin concentrates received at the Government Laboratory from Greenbushes. These proved to be xenotime, and this is the first recorded finding of the mineral in Australia. Since then the mineral has been found to occur at several places near Greenbushes, and also in the Central and Northern parts of the State, as a minor constituent of pegmatites, or in alluvial concentrates. The crystals are, with the exception of those from one locality, minute in size, and of a dull yellow or pale brown colour. Because of the minute size of the crystals and their common association with zircon a detailed description and an analysis was not made of them.

In composition xenotime is a rare earth phosphate, the rare earths being essentially of the yttrium group. The formula is YPO_4 . Yttrium usually predominates, although some analyses show a large proportion of erbium.

Yinnietharra Xenotime.

At Yinnietharra in the Gascoyne district one detrital pebble 2 cm. in size was first found. This piece had a resinous lustre and showed imperfect cleavage. A larger piece has recently been recovered from the same locality. This mass measured $4\frac{1}{2} \times 3 \times 2\frac{1}{2}$ cm., and weighed 150 grams, which enabled a more complete description and an analysis of the mineral as occurring in this district to be made.

In appearance this specimen is pale olive green in colour with a vitreous lustre. The cleavage is nearly perfect in two directions and there is a fairly well defined parting. The surface is covered with a reddish-brown alteration product which penetrates the mass as a staining. In thin splinters the mineral appears greenish and translucent by reflected light. Examined under the microscope the fine powder is colourless and transparent by transmitted light, while the larger grains are yellowish brown in colour.

By coarse crushing and hand picking fresh portions of the mineral almost free from alteration products were selected for analysis. The specific gravity of this material was 4.55.

The analytical results obtained by the author are as follows:—

	%
*Y ₂ O ₃ group	59·42
Ce ₂ O ₃ + La, Di groups	·14
Fe ₂ O ₃	1·19
Al ₂ O ₃	<i>nil</i>
ThO ₂	1·65
ZrO ₂	·23
TiO ₂	·01
SiO ₂	1·76
UO ₃	2·19
MnO	Tr.
CaO	<i>nil</i>
MgO	·16
PbO	·16
P ₂ O ₅	33·38
As, Sb, Sn	<i>nil</i>
H ₂ O+	·29
H ₂ O—	·05
	100·63

* Y₂O₃ group, Mol. Wt. 249, calculated as Y₂O₃ 46·03% ; Er₂O₃, etc. 13·39%.

The mineral was found to be difficult to decompose completely by fusion with alkali carbonates. It is not attacked by nitric or hydrochloric acids, but the fine powder is completely soluble in fuming sulphuric acid.

Of interest is the amount of uranium and thorium found to be present. The calculated radium content is .0063 grams per ton. Uranium bearing xenotime is also known to occur at Holleton.

XENOTIME IN THE SOUTH-WEST.

Holleton.—A prospector at Holleton while concentrating a biotitic albite pegmatite to determine if it contained gold, obtained a heavy yellow concentrate consisting mainly of xenotime. Several samples were examined. They yielded about 1% of concentrate consisting of 88% to 92% of xenotime, the rest being mainly zircon. During 1929, under the name of the "Radium Mine" this coarse pegmatite, which is on the west slope of Mt. Lookout, was worked for the mineral. The biotitic portions were found to carry up to 1% xenotime, but no richer material was located. Four samples examined gave the following results:—

	I.	II.	III.	IV.
Rock	Biotitic	Biotitic	Biotitic	Felspathic
Total concentrate (%) ...	·81	1·10	·90	·75
Xenotime (%)	·71	1·00	·83	Trace

The chief associated heavy minerals were zircon, ilmenite and epidote. A partial analysis of two concentrates was made to determine the possible amount of radium that might be expected to be present. The results of these are given below.

	(a)	(b)
Rock	Mainly biotite	Biotite, quartz, etc.
Concentrate (%)	·86	·62
Rare earths (%)	61·14	60·14
UO ₃ (%)	·99	·91
Radium (grams per ton)	·0028	·0026

Analyst: D. G. Murray.

The xenotime occurred in minute yellow transparent and translucent octahedral crystals.

The other localities at which the mineral has been found in the South-West are as follows:—

Greenbushes.—(a) In a concentrate from Kelly's Flat consisting mainly of ilmenite and zircon; (b) a concentrate from Poverty Flat consisting mostly of ilmenite, zircon and kyanite. Both contained a few minute crystals of xenotime. These were dull yellow octahedral crystals, a few of the larger being 0.5 to 2.0 mm., in diameter.

Smithfield.—Small crystals of xenotime were found to be present in an alluvial concentrate which consisted of monazite, xenotime, gahnite, ilmenite, rutile and zircon. In another alluvial concentrate from the same district it was associated with ilmenite, cassiterite, magnetite and garnet.

Donnybrook.—A stream sand contained a little xenotime associated with ilmenite, rutile, zircon, kyanite and magnetite.

Lowden.—Two small greenish brown, translucent crystals were found here.

Westonia.—The concentrate from a microcline pegmatite was found to consist of a few small crystals of xenotime.

NORTH-WEST AND CENTRAL DISTRICTS.

Besides the previously described occurrence at Yinnietharra, xenotime has been found at Nullagine and Abydos in the North-West, and Niagara in the Central Division.

Nullagine.—On the south side of Grant's Flat, $\frac{1}{2}$ mile from the town, xenotime has been found in alluvium as water worn lenticular pebbles 2 to 5 mm. in diameter. These pebbles are a dull yellow or brownish black colour.

Another sample from Nullagine, a sandy and gravelly concentrate, was also found to contain xenotime among the following heavy minerals: monazite, barite, limonite, tantalite, ilmenite, magnetite, chromite, rutile, zircon, cassiterite, pyrite and gold. A partial analysis of this concentrate gave the following results:—

	%
SiO ₂	16·08
Fe ₂ O ₃	31·43
(TaNb) ₂ O ₅	4·72
P ₂ O ₅	6·04
Ce ₂ O ₃	3·51
Y ₂ O ₃	5·30
ThO ₂	·52
TiO ₂	9·15
BaSO ₄	10·44
Ign.	2·85
Al ₂ O ₃ , CaO, Alkalies, etc. ...	(9·96)
	100·00

Analyst: D. G. Murray.

Abydos.—A few small crystals were detected in a fine grained concentrate which consisted mostly of spessartite, with some monazite, cassiterite, tanteuxenite, haematite and limonite.

Niagara.—A few minute crystals were found in the concentrate from a pegmatite.

SUMMARY.

The localities known to the Government Laboratory in which the mineral xenotime has been found in Western Australia are given. The main occurrences are described in detail, including a recent analysis of the mineral from Yinnietharra.

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